Data Collection for Class-8 Long Haul Operations and Fuel Economy Analysis

As part of a long-term study sponsored by the U.S. Department of Energy (DOE) Office of Vehicle Technologies (OVT), the Oak Ridge National Laboratory (ORNL) in conjunction with a number of industry partners (Michelin Americas Research Company – Michelin), have collected data and information related to Class-8 heavy truck long-haul operations in real-world highway environments. Six Class-8 tractors and ten box-trailers were selected for instrumentation from a fleet that operated within a large area of the country; extending from the east coast to the Mountain Time Zone, and from Canada to the US-Mexican border. Instrumentation for each tractor-trailer provided sixty channels of data, collected at 5 Hz (five times per second), over a period of at least 12 months. Data was collected from the vehicle's data bus (e.g., instantaneous fuel rate, engine speed, gear ratio, and vehicle speed); an on-board weather station (e.g., wind speed, precipitation, and air temperature); a Global Positioning System (GPS) (for spatial information such as latitude, longitude, and altitude); and an on-board real-time vehicle weight system which gave the weight at each of the tractor-trailer axles. Three tractors and five trailers were equipped with Michelin's New-Generation Single Wide-Based Tires (NGSWBTs or S), and two tractors and five trailers utilized standard dual tires (Duals or D). The instrumented vehicles traveled more than 700,000 miles (see Table 1 for details) and resulted in 290 Giga-Bytes of data. The collected data: (1) supports the continued development of DOE's Powertrain Systems Analysis Toolkit (PSAT), (2) provides data to conduct independent evaluations of PSAT, (3) provides a source of real-world heavy-truck performance data that can be utilized by DOE for making decisions related to future technology investments, (4) provides a baseline of data that can be utilized to gauge DOE's 21st Century Truck Partnership (21CTP) technology advancements, and (5) provides a national source of real-world data for the heavy-truck research community. An initial fuel efficiency study was conducted with regard to tire type and payload, speed and road grade. The fuel efficiency benefits of the NGSWBTs are significant for all of the cases studied, and provided from 6% to over 10% fuel savings depending on the situation. Results of the fuel efficiency studies are presented in Figures 1 through Figure 4.

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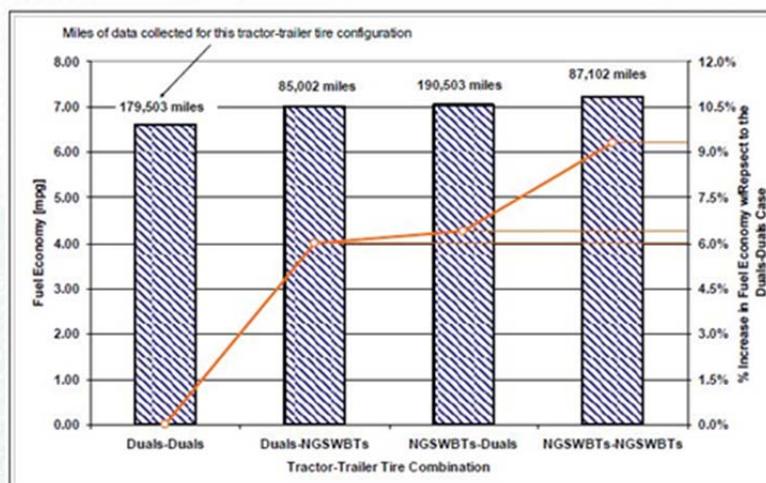ORNL is managed by UT-Battelle for the US Department of Energy

Figure 1. Class-8 truck fuel economy comparison by truck-tire configuration. (Averages computed using fuel efficiencies calculated for 100-mile segments.)
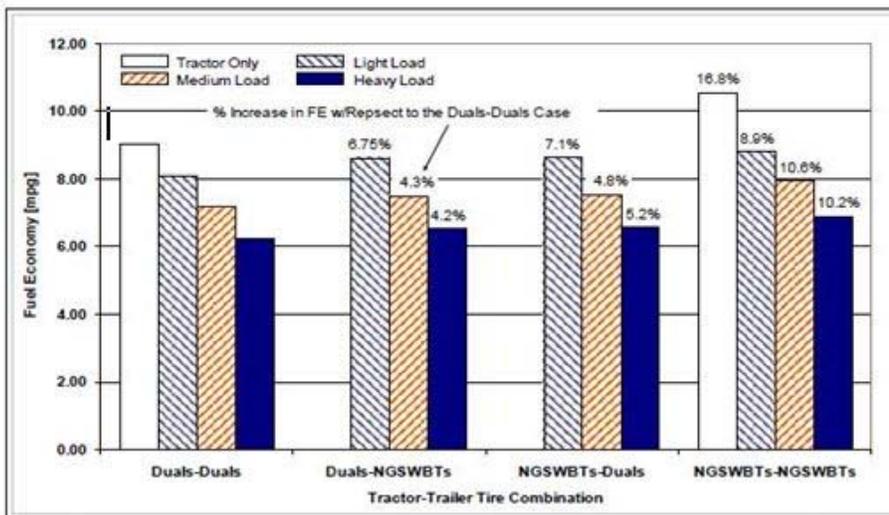
Figure 2. Fuel economy for Class-8 trucks as a function of payload and truck-tire configuration.
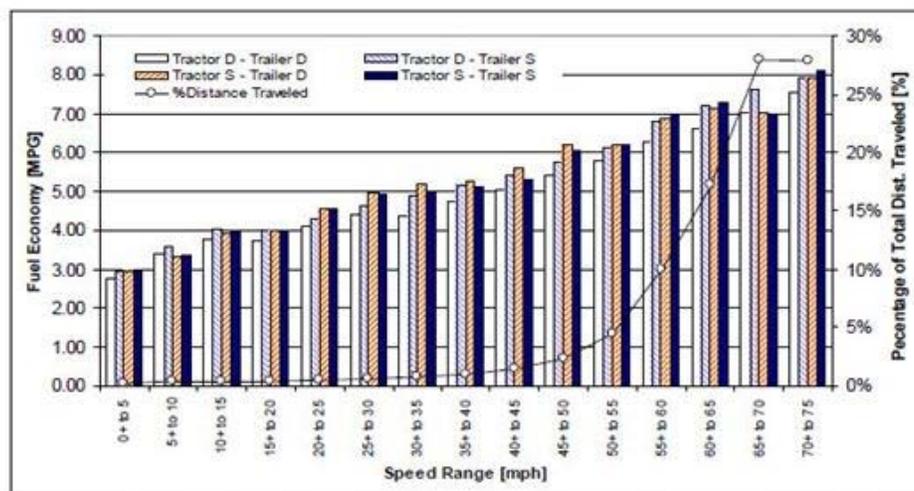

Figure 3. Fuel economy for Class-8 trucks as a function of speed and tractor-trailer tire combination (Left ordinate) and percentage of total distance traveled as a function of speed (Right ordinate).
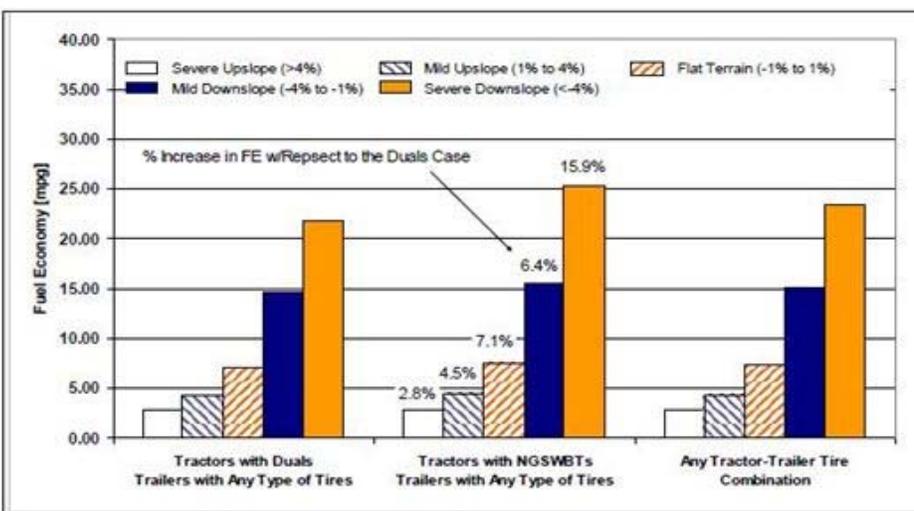

Figure 4. Fuel economy for Class-8 trucks as a function of type of terrain and type of tractor tires.

Table 1. General Statistics for the Six Instrumented Tractors

Statistics	T1 $(M^1\text{-}S^4)$	T2 $(M^1\text{-}D^8)$	T3 $(A^2\text{-}S^4)$	T4 $(M^1\text{-}D^8)$	T5 $(A^2\text{-}S^4)$	T6 $(A^2\text{-}D^8)$	Grand Total
Distance Traveled [miles]	106,891	114,095	117,355	124,917	127,626	97,417	688,302
Total Time for which Data was Collected[3] [hrs]	3,783	4,451	3,779	4,413	4,281	3,067	23,774
Avg. Speed[4] [mph]	28.26	25.63	31.05	28.31	29.81	31.76	28.95
Total Fuel Consumed [gal]	15,982	16,701	16,805	19,361	18,494	15,995	103,336
Overall Fuel Economy [mpg] from the Databus Sensor	6.69	6.83	6.98	6.45	6.90	6.09	6.66